

**CLAIMS**

We claim:

1. A method of preheating a substrate which includes a metal-containing layer to a  
2 temperature of at least 150 °C, wherein said method comprises exposing said substrate  
3 to a preheating plasma which is sufficiently reactive with said metal-containing layer  
4 that a deposit or residue formed during preheating which includes metal from said metal-  
5 containing layer is more easily etched than said metal-containing layer during a  
6 subsequent plasma etching of said metal-containing layer, wherein said metal is selected  
7 from the group consisting of platinum, iridium, ruthenium, and combinations thereof..

1. The method of Claim 1, wherein said metal-containing layer is a platinum-  
2 containing layer and a first source gas used to produce said preheating plasma includes  
3 nitrogen.

1. 3. The method of Claim 2, wherein said platinum-containing layer is platinum.

1. 4. The method of Claim 2 or Claim 3, wherein said first source gas is at least 50  
2 % by volume nitrogen.

1. 5. The method of Claim 4, wherein a second plasma source gas used during  
2 subsequent plasma etching of said platinum-containing layer or said platinum layer is at  
3 least 15 % by volume nitrogen.

1. 6. The method of Claim 1, wherein said metal-containing layer is a ruthenium-  
2 containing layer and a first source gas used to produce said preheating plasma includes a  
3 gas selected from the group consisting of nitrogen, oxygen, and combinations thereof.

1       7.       The method of Claim 6, wherein said ruthenium-containing layer is ruthenium  
2       oxide.

1       8.       The method of Claim 6, wherein said ruthenium-containing layer is ruthenium.

1       9.       The method of Claim 7 or Claim 8, wherein said first source gas is at least 50 %  
2       by volume nitrogen.

1       10.      The method of Claim 9, wherein said first source gas is nitrogen.

1       11.      The method of Claim 7 or Claim 8, wherein said first plasma source gas is at  
2       least 50 % or more oxygen by volume.

1       12.      The method of Claim 11, wherein said first plasma source gas is oxygen.

1       13.      The method of Claim 9, wherein a second plasma source gas used during  
2       subsequent plasma etching of said ruthenium-containing layer is at about 70 % or more  
3       oxygen by volume.

1       14.      The method of Claim 10, wherein a second plasma source gas used during  
2       subsequent plasma etching of said ruthenium-containing layer is about 70 % or more  
3       oxygen by volume.

1       15.      The method of Claim 11, wherein a second plasma source gas used during  
2       subsequent plasma etching of said ruthenium-containing layer is at about 70 % or more  
3       oxygen by volume.

1       16.      The method of Claim 12, wherein a second plasma source gas used during

2 subsequent plasma etching of said ruthenium-containing layer is about 70 % or more  
3 oxygen by volume.

1 17. The method of Claim 1, wherein said metal-containing layer is an iridium-  
2 containing layer and a first source gas used to produce said preheating plasma includes a  
3 gas selected from the group consisting of nitrogen, oxygen, and combinations thereof.

1 18. The method of Claim 17, wherein said iridium-containing layer is iridium  
2 oxide.

1 19. The method of Claim 17, wherein said iridium-containing layer is iridium.

1 20. The method of Claim 18 or Claim 19, wherein said first source gas is at least  
2 50 % by volume nitrogen.

1 21. The method of Claim 20, wherein said first source gas is nitrogen.

1 22. The method of Claim 18 or Claim 19, wherein said first plasma source gas is  
2 about 50 % or more oxygen by volume.

1 23. The method of Claim 22, wherein said first plasma source gas is oxygen.

1 24. The method of Claim 20, wherein a second plasma source gas used during  
2 subsequent plasma etching of said iridium-containing layer is at about 70 % or more  
3 oxygen by volume.

1 25. The method of Claim 21, wherein a second plasma source gas used during  
2 subsequent plasma etching of said iridium-containing layer is at about 70 % or more

3       oxygen by volume.

1       26.       The method of Claim 22, wherein a second plasma source gas used during  
2       subsequent plasma etching of said iridium-containing layer is at about 70 % or more  
3       oxygen by volume.

1       27.       The method of Claim 23, wherein a second plasma source gas used during  
2       subsequent plasma etching of said iridium-containing layer is at about 70 % or more  
3       oxygen by volume.

1       28.       A method of plasma heating a substrate and etching a platinum-containing layer  
2       included in said substrate, said method comprising:

- 3           a)       supplying a first nitrogen-comprising plasma source gas to a process  
4       chamber containing said substrate;
- 5           b)       preheating said substrate to a temperature of at least 150 °C using ion  
6       bombardment from a plasma generated from said first nitrogen-comprising plasma  
7       source gas;
- 8           c)       supplying a second nitrogen-comprising plasma source gas to said process  
9       chamber; and
- 10          d)       forming a plasma from said second nitrogen-comprising source gas to  
11       etch said platinum-containing layer while removing platinum-comprising deposits  
12       generated during said preheating of said substrate.

1       29.       The method of Claim 28, wherein said first nitrogen-comprising plasma  
2       source gas contains at least 50 % nitrogen by volume.

1       30.       The method of Claim 29, wherein said first nitrogen-comprising plasma  
2       source gas is nitrogen.

1       31.       The method of Claim 28 or Claim 29, wherein said second nitrogen-  
2       comprising plasma source gas contains about 15 % or more nitrogen by volume.

1       32.       The method of Claim 31, wherein said second nitrogen-comprising plasma  
2       also includes at least one inert, non-reactive gas selected from the group consisting of  
3       helium, neon, argon, krypton xenon, and combinations thereof..

1       33.       A method of plasma heating a substrate and etching a ruthenium-containing  
2       layer included in said substrate, said method comprising:

3           a)       supplying a first plasma source gas comprising a gas selected from the  
4       group consisting of nitrogen, oxygen, or combinations thereof into a process chamber  
5       containing said substrate;

6           b)       preheating said substrate to a temperature of at least 150 °C using ion  
7       bombardment from a plasma generated from said first plasma source gas;

8           c)       supplying a second plasma source gas comprising oxygen to said process  
9       chamber; and

10           d)       forming a plasma from said second source gas to etch said ruthenium-  
11       containing layer while removing ruthenium-comprising deposits generated during said  
12       preheating of said substrate.

1       34.       The method of Claim 33, wherein said ruthenium-containing layer is  
2       ruthenium oxide.

1       35.       The method of Claim 33, wherein said ruthenium-containing layer is  
2       ruthenium.

1       36.       The method of Claim 34 or Claim 35, wherein said first source gas is at least

2 50 % by volume nitrogen.

1 37. The method of Claim 36, wherein said first source gas is nitrogen.

1 38. The method of Claim 34 or Claim 35, wherein said first source gas is about 50  
2 % or more oxygen by volume.

1 39. The method of Claim 38, wherein said first plasma source gas is oxygen.

1 40. The method of Claim 36, wherein said second plasma source gas used during  
2 subsequent plasma etching of said ruthenium-containing layer is at about 70 % by  
3 volume or more oxygen.

1 41. The method of Claim 37, wherein said second plasma source gas used during  
2 subsequent plasma etching of said ruthenium-containing layer is about 70 % by volume  
3 or more oxygen.

1 42. The method of Claim 38, wherein said second plasma source gas used during  
2 subsequent plasma etching of said ruthenium-containing layer is at about 70 % by  
3 volume or more oxygen.

1 43. The method of Claim 39 wherein said second plasma source gas used during  
2 subsequent plasma etching of said ruthenium-containing layer is about 70 % by volume  
3 or more oxygen.

1 44. A method of plasma heating a substrate and etching an iridium-containing  
2 layer included in said substrate, said method comprising:

3 a) supplying a first plasma source gas comprising a gas selected from the

4 group consisting of nitrogen, oxygen, and combinations thereof into a process chamber  
5 containing said substrate;.

6 b) preheating said substrate to a temperature of at least 150 °C using ion  
7 bombardment from a plasma generated from said first plasma source gas;

8 c) supplying a second plasma source gas to said process chamber; and

9 d) forming a plasma from said second source gas to etch said iridium-  
10 containing layer while removing iridium-comprising deposits generated during said  
11 preheating of said substrate..

1 45. The method of Claim 44, wherein said second source gas includes oxygen.

1 46. The method of Claim 44 or Claim 45, wherein said iridium-containing layer is  
2 iridium oxide.

1 47. The method of Claim 44 or Claim 45, wherein said iridium-containing layer is  
2 iridium.

1 48. The method of Claim 44, wherein said first source gas is at least 50 % by  
2 volume nitrogen.

1 49. The method of Claim 44, wherein said first source gas is about 50 % or more  
2 oxygen by volume.

1 50. The method of Claim 45, wherein said second plasma source gas used during  
2 subsequent plasma etching of said iridium-containing layer is at about 70 % by volume  
3 or more oxygen.

1 51. The method of Claim 46, wherein said second plasma source gas used during

2       subsequent plasma etching of said iridium-containing layer is about 70 % by volume or  
3       more oxygen.

1       52. The method of Claim 47, wherein said second plasma source gas used during  
2       subsequent plasma etching of said iridium-containing layer is at about 70 % by volume  
3       or more oxygen.

1       53. The method of Claim 48, wherein said second plasma source gas used during  
2       subsequent plasma etching of said iridium-containing layer is at about 70 % by volume  
3       or more oxygen.

1       54. The method of Claim 49, wherein said second plasma source gas used during  
2       subsequent plasma etching of said iridium-containing layer is at about 70 % by volume  
3       or more oxygen.

1       55. The method of Claim 50, wherein said second plasma source gas includes an inert,  
2       non-reactive gas selected from the group consisting of helium, neon, argon.

1       56. The method of Claim 51, wherein said second plasma source gas includes an inert,  
2       non-reactive gas selected from the group consisting of helium, neon, argon.

1       57. The method of Claim 52, wherein said second plasma source gas includes an inert,  
2       non-reactive gas selected from the group consisting of helium, neon, argon.